About this online resource

This online resource is intended to improve participant awareness of how to best manage the health and safety risks associated with the use and management of flammable refrigerants in stationary refrigeration and air conditioning equipment.

This covers refrigeration and air conditioning equipment that could be used at a workplace, public building or in a residential or domestic setting. It includes how to best manage the health and safety risks during design, manufacture, installation, commissioning, service, use, decommissioning, dismantling and disposal of refrigeration and air conditioning equipment using flammable refrigerants.

This online resource is designed to raise awareness and refresh and complement existing knowledge. It does NOT replace technical training on flammable refrigerants and does NOT substitute for the detailed nationally endorsed technical training (discussed in Module 8) offered by Registered Training Organisations.

All refrigeration technicians that handle flammable refrigerants must be trained to be competent in their use. Refrigeration technicians must have access to refrigeration classification standard AS/NZS ISO 817 and design standards AS/NZS 5149 (parts 1 to 4). This online resource will help refrigeration technicians and apprentices and other stakeholders understand the range of skills and knowledge required to work safely with flammable refrigerants.

Designers, installers and service providers should access the AS/NZS 5149 *Refrigerating systems and heat pumps – Safety and environmental requirements series* in order to understand the precise requirements for an individual installation.

This online resource does not substitute for the detailed nationally endorsed technical training which provides guidance on how to safely and productively work with flammable refrigerants.

Navigating this online resource

This online resource is divided into eight separate modules, which deal with the health and safety issues across the life-cycle of an air conditioning and refrigerating system. It is recommended that modules are completed in order, however you are able to select and complete modules out of sequence. Completing the modules in order helps to build up an understanding of all the issues from a solid foundation.

Each module takes 15 to 20 minutes to complete and detailed guidance notes are provided as a downloadable PDF for follow-up reading.

Each individual module forms a stand-alone element and includes ‘test your understanding’ questions to ensure you understand the key insights provided and to check your awareness of the key issues.

Participants who register and complete all eight modules will be issued with an AIRAH continuing professional development (CPD) certificate. This certificate indicates that you have completed the FRSG Online awareness resource on how to best manage the health and safety risks associated with the use and management of flammable refrigerants in refrigeration and air conditioning equipment. Please note again, this certificate does NOT replace or contribute to any formal nationally endorsed training qualification.

Remember to read the FRSG, the referred standards and the FRSG Update 1 2018 for more complete information on each topic.

Online resource contents

This online resource is divided into eight separate stand-alone modules.

Module 1: About Flammable Refrigerants

This module provides information to raise awareness about the use of flammable refrigerants under the following topic headings:

- Why we need flammable refrigerants
- Refrigerant GWP and the relationship between flammability and GWP
- Fundamental safety rules for flammable refrigerants
- The Flammable Refrigerants Safety Guide and its Update 1 2018
- How Refrigerant classification works
- Flammable limits and Flammability Class
- AS/NZS ISO 817 flammability sub-category A2L
- What is not included in AS/NZS ISO 817 refrigerant classification
- Refrigerant legislation and international agreements
- The roll out of Australia's HFC phase-down
- Australian standards for refrigeration

Module 2: Managing Refrigerant Flammability Risk

This module provides information to raise awareness about managing risks from flammable refrigerant, under the following topic headings:

- The fire triangle – the core elements that result in fire
- Lower Flammability Limit or LFL and Upper Flammability Limit UFL
- What can happen when things go wrong?
- The lessons learned from previous incidents
- Flammable Refrigerants Safety Guide
- Risk management approach to safety
- Controlling risks – minimisation, ignition, ventilation, detection
- Safety Alerts – issued for flammable refrigerants
- GHS and its relationship to the ADG code

Module 3: Hazardous Areas and Temporary Flammable Zones

This module provides information to raise awareness about 'Hazardous Areas' and 'Temporary Flammable Zones' when using flammable refrigerants, under the following topic headings:

- Hazardous area classification - AS/NZS 60079.10.1
- Hazardous area classification - WHS
- Temporary Flammable Zones

- Temporary flammable zone rules
- Safety checks for the work area
- Identifying ignition sources
- Controlling ignition sources
- Controlling ventilation
- Safety when breaking in to systems

Module 4: Design Rules for flammable refrigerants

This module provides information to raise awareness about the critical aspects of refrigerating systems design for flammable refrigerants, under the following topic headings:

- Classification and selection standard - AS/NZS 5149.1
- AS/NZS ISO 817 Refrigerant classification
- Occupancy classification - AS/NZS 5149.1
- System classification - AS/NZS 5149.1
- Location classification - AS/NZS 5149.1
- Maximum quantity of refrigerant allowed - AS/NZS 5149.1 or AS/NZS 60335.2.40
- Charge calculation procedures - AS/NZS 5149.1 or AS/NZS 60335.2.40
- Exceeding charge limits for flammable refrigerants – AS/NZS 5149.1
- Appliance charge limits - AS/NZS 60335.2.40 annex GG
- Design requirements - AS/NZS 5149.2
- Design Registration – WHS regulations

Module 5: Installation rules for flammable refrigerants

This module provides information to raise awareness about the critical aspects of the Installation rules for flammable refrigerants, under the following topic headings:

- System construction standards – AS/NZS 5149.2
- Installation stringency for flammable refrigerants
- Flammability risk assessment for the installation
- System installation procedures
- Appliance installation procedures
- Requirements for connectors
- Tightness of components and fittings
- Leak minimisation – best practice installation
- Site installation standards – AS/NZS 5149.3
- Machinery rooms and special machinery rooms
- Warnings and labelling
- FRSG updated installation checklists

Module 6: System conversion rules

This module provides information to raise awareness about the critical aspects of the issues surrounding changing the refrigerant in an existing system, under the following topic headings:

- Replacing refrigerants in existing systems
- Difference between 'Drop-in replacement' and 'system conversion'
- Regulations for system conversions
- Changing refrigerant flammability classification
- Competence and responsibilities to undertake a conversion
- System suitability assessment
- Conversion Standards - AS/NZS 5149 parts 1 to 3
- Conversion Procedures - AS/NZS 5149.4

Module 7: Maintenance with flammable refrigerants

This module provides information to raise awareness about the issues surrounding maintenance safety and flammable refrigerants, under the following topic headings:

- Risks during maintenance
- Competency in maintenance
- Maintenance of the site
- Maintenance of the system - standards
- Maintenance of the system - procedures
- Preventative maintenance
- Leak detection technology
- Leakage situation – Emergency procedures
- Personal protection
- Pre-service assessment
- Temporary flammable zones
- Tools and equipment
- Accessing systems
- Refrigerant recovery
- Refrigerant reuse, recycle, reclaim or destruction

Module 8: Handling flammable refrigerants

This module provides information to raise awareness about the issues surrounding the safe handling of flammable refrigerants, under the following topic headings:

- The main types of flammable refrigerants on the market
- Odourant for flammable refrigerants
- Refrigerant handling hazards and methods to avoid them
- The rules for managing refrigerant
- Refrigerant reuse or recycling

- The rules that apply when storing flammable refrigerants
- The rules that apply when transporting flammable refrigerants
- Classification differences between AS/NZS ISO 817 and GHS/ADG
- Training and competency
- Competency standards
- Refrigeration and air conditioning training
- Environmental licensing
- State-based licensing systems
- ARC Green Scheme Accreditation

Acronyms

The following acronyms are used throughout this online resource -

ADG Australian Dangerous Goods Code
CFC Chlorofluorocarbon
FRSG Flammable Refrigerants Safety Guide
GHS Globally Harmonised System for the Classification and Labelling of Chemicals
GWP Global Warming Potential
HCFC Hydrochlorofluorocarbon
HFC Hydrofluorocarbon
HFO Hydrofluoro-olefine
LFL Lower Flammability Limit*
ODP Ozone Depletion Potential
OFDN Oxygen-free dry nitrogen
OHS Occupational Health and Safety
PPE Personal Protective Equipment
PCBU Person Conducting Business or Undertaking*
QLMV Quantity Limit with Minimum Ventilation
QLAV Quantity Limit with Additional Ventilation
RCL Refrigerant Charge Limit
UFL Upper Flammability Limit*
WHS Work Health and Safety

*Refer to 1.4 of the FRSG for the meaning of key terms

Documents referred

Flammable Refrigerants Safety Guide (FRSG)

Flammable Refrigerants Safety Guide – Update 1-2018 (FRSG Update 1)

AS/NZS 5149 *Refrigerating systems and heat pumps—Safety and environmental requirements*

AS/NZS 5149.1 Part 1 *Definitions, classification and selection criteria* (ISO 5149-1:2014, modified)

AS/NZS 5149.2 Part 2 *Design, construction, testing, marking and documentation* (ISO 5149-2:2014, modified)

AS/NZS 5149.3 Part 3 *Installation site* (ISO 5149-3:2014, modified)

AS/NZS 5149.4 Part 4 *Operation, maintenance, repair and recovery* (ISO 5149-4:2014, modified)

AS/NZS 60335.2.40 *Particular requirements for electrical heat pumps, air conditioners and dehumidifiers*

A study into HFC consumption in Australia, Peter Brodribb and Michael McCann 2014, Canberra

An introduction to A2L refrigerants and their use in Refrigeration, Air Conditioning and Heat Pump applications, Federation of Environmental Trade Associations Ltd, 2017

Acknowledgements

Base technical materials

These online resource modules have been based on the following materials:

- Flammable Refrigerants Safety Guide – Update 1-2018 (FRSG Update 1)
- Flammable Refrigerants Safety Guide (FRSG) – AIRAH 2013
- Flammable Refrigerants Safety – Fact Sheets 1, 2 and 3 - AIRAH 2014
- AIRAH Technical Handbook – Edition 5 – AIRAH 2013
- AIRAH Management guideline for the phase-out of refrigerant R22 - Impacts and strategies for building owners, operators and maintainers – AIRAH 2015
- AIRAH Seminars - Flammable Refrigerants – How to Apply Safely - Kevin Lee M.AIRAH 2015
- AIRAH Seminars - Refrigeration Standards Update - Safety and Environmental Requirements - AS/NZS ISO 817 and AS/NZS 5149 (Part 1 to Part 4) - AIRAH Qld Seminar – Kevin Lee M.AIRAH 14th Feb. 2017
- AIRAH NSW Division Seminar – New Refrigerating System Standards - Update on the replacement of AS/NZS 1677.1 by AS/NZS/ISO 817 and AS/NZS 1677.2 by AS/NZS 5149 Parts 1 to 4. - Robert Beggs M.AIRAH - 17 August 2016
- AIRAH Ecolibrium – Is it safe? - November 2016
- AIRAH HVAC&R NATION Skills Workshops -
    - Module 110 Refrigerating systems and heat pumps – Safety and environmental requirements – Part 2 April 2018
    - Module 102 Refrigerating systems and heat pumps – Safety and environmental requirements – Part 1 June 2017
    - Module 101 Update on new refrigerants designations and safety classifications – May 2017
    - Module 97 Refrigerant leaks – Causes, cures, and prevention – November 2016
    - Module 75 Refrigerant recovery – September 2014
    - Module 74 Flammable refrigerants – Operation and maintenance – August 2014
    - Module 54 –Refrigerant Bank – Part Two: Protecting it – August 2012
    - Module 53 Refrigerant Bank – Part One: Defining it – July 2012

  - Module 50 Guidelines for gas cylinder safety Part 2 – April 2012
  - Module 49 Guidelines for gas cylinder safety – March 2012
- AIRAH HVAC&R NATION Features –
  - The roll-out continues – Feature September 2017
  - Coming soon: HFC Phase-down – Feature March 2017
  - Staking a Reclaim – Feature June 2015
  - The lowdown on R32 – Cover story November 2013
  - What's the cost of a leak? – Cover story September 2012
- AS/NZS 5149 Refrigerating systems and heat pumps—Safety and environmental requirements
  - AS/NZS 5149.1 Part 1 *Definitions, classification and selection criteria* (ISO 5149-1:2014, modified)
  - AS/NZS 5149.2 Part 2 *Design, construction, testing, marking and documentation* (ISO 5149-2:2014, modified)
  - AS/NZS 5149.3 Part 3 *Installation site* (ISO 5149-3:2014, modified)
  - AS/NZS 5149.4 Part 4 *Operation, maintenance, repair and recovery* (ISO 5149-4:2014, modified)
- AS/NZS 60335.2.40 *Particular requirements for electrical heat pumps, air conditioners and dehumidifiers*
- *A study into HFC consumption in Australia*, Peter Brodribb and Michael McCann 2014, Commonwealth of Australia 2014
- *Analysis of Work Health and safety Data for the use of Synthetic Greenhouse Gases and substitutes in the Refrigeration and Air-Conditioning Industry*, David Caple and Associates, August 2015
- ASHRAE presentation - *International Refrigerant Standards and their Influence on the Global HVAC Industry and Refrigerant Replacement* - Tom Watson - President ASHRAE
- *Benchmarking risk by whole room scale leaks and ignitions testing of a2l refrigerants* Final Report - AHRTI Report No. 9007-01 – June 2017
- *Equipment for refrigerants with lower (A2L) and higher (A3) flammability* - European organisation of air-conditioning, refrigeration and heat pumps contractors - Version 1.0 April 2016
- *GHS - What you need to know* – Safework NSW - Updated December 2016
- Informatory Note – *Qualification and Certification of Refrigeration Technicians* - International Institute of Refrigeration – September 2015
- Informatory Note – *Containment of Refrigerants within Refrigeration, Air Conditioning and Heat Pump Systems* – International Institute of Refrigeration – January 2014
- *Inquiry into the Explosion and Fire at Icepacks Coolstores, Tamahere, on 5 April 2008*: New Zealand Fire Service Commission - September 2008
- Mines Safety Bulletin No. 100 and Dangerous Goods Safety Bulletin No. 0312 - *Safe use of flammable refrigerants* – Government of WA - August 2012
- Real Alternatives Europe – The Institute of Refrigeration (UK) and partners 2015 -
  - Programme Guide 3: *Containment and leak detection of alternative refrigerants*
  - Programme Guide 4: *Maintenance and repair of alternative refrigerant systems*
  - Programme Guide 5: *Retrofitting existing systems with low GWP alternatives*

- *Refrigerant emissions in Australia: Sources, causes and remedies*, prepared by the Expert Group for the Department of the Environment, Water, Heritage and the Arts, 2010
- *Safe Use of HCFC Alternatives in Refrigeration and Air-conditioning: An overview for developing countries*, UNEP OzonAction – 2015
- Safety Alert – *Safe use of flammable refrigerants* – Worksafe Victoria – December 2016
- *Safe Servicing of Household Appliances with Flammable Refrigerants: - Recommended Practices* - The Association of Home Appliance Manufacturers AHAM – September 2017
- *The Montreal Protocol Evolves to Fight Climate Change - United Nations Industrial Development Organisation (UNIDO)*
- *Understanding refrigerant flammability* – KTH Royal Institute of Technology – June 2015
- *Work Health and Safety Regulations: Classification and labelling for workplace hazardous chemicals* – Safe Work Australia – 2012
- White paper: *The next generation refrigerant for air conditioners and heat pumps* – Daikin – October 2015

Pictures and figures

Many of the pictures and figures reproduced in this online resource have been sourced from the above publications and –

- AIRAH HVAC&R Nation and Ecolibrium stories and features
- Department of the Environment and Energy – Environment protection website pages

Individuals

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